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PROCEDURE FOR AIR QUALITY DISPERSION MODELING
FOR THE ARIZONA HAPRACT RULE

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Date: Revised 5 July 2005

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List of Acronyms

AAC - ambient air concentrations
ADEQ - Arizona Department of Environmental Quality
A.R.S. - Arizona Revised Statutes
CAAA - Clean Air Act Amendments
EPA – Environmental Protection Agency
g/s – grams per second
HAP - Hazardous Air Pollutants
HAPRACT - Hazardous Air Pollutant Reasonable Available Control Technology
MACT - Maximum Achievable Control Technology
RMA - Risk Management Analysis
SIC - Standard Industrial Classification
TRI - Toxic Release Inventory
tpy - ton per year

1.0 INTRODUCTION

In 1992, Arizona Revised Statutes (A.R.S) §49-426.02, §49-426.05, and §49-426.06 were enacted directing the Arizona Department of Environmental Quality (ADEQ) to develop regulations to control sources of hazardous air pollutants (HAPs) that would not be addressed by federal regulations under §112 of the Clean Air Act Amendments (CAAA) of 1990. The laws directed that the rulemaking propose methods for case-by-case imposition of control technology for new and modified sources of HAPs. These statutes also required the installation of Hazardous Air Pollutant Reasonable Available Control Technology (HAPRACT) for sources in specified source categories that emit more than 1 ton per year (tpy) of a single HAP or 2.5 tpy of a combination of HAPs. The statutes required that the regulations also specify source categories not identified in the federal program that would be subject to HAPRACT. The statues allowed a source to demonstrate that the imposition of Maximum Achievable Control Technology (MACT) or HAPRACT may not be necessary to avoid adverse health or environmental impacts by preparing a Risk Management Analysis (RMA) considering estimated exposure, available epidemiological or other health studies, background concentrations, and uncertainties in risk or health assessments or other studies.

The objective of the current project is to adopt contemporary rules under these statutes by the end of calendar year 2005. In order to adopt these rules ADEQ must develop a list of source categories with emissions in excess of the 1 tpy or 2.5 tpy thresholds that will be subject to the program, determine whether these emissions will have adverse impacts on human health or the environment, and adopt de minimus amounts for purposes of identifying modifications at existing sources. The regulations will distinguish between federal HAPs listed in §112 of the CAAA and those listed under state regulations.

This document provides the approach that will be used to determine impacts of HAPs from the chosen facilities, to be considered as potentially subject to HAPRACT requirements. The document also addresses the procedures to be followed to model the facilities to determine their potential impacts on the surrounding communities. A separate document will address the approach to developing a de minimus process.

2.0 MODELING OVERVIEW

The objective of the modeling analysis will be to determine if an industry, as defined by its primary 4-digit Standard Industrial Classification (SIC) code, may be subject to the HAPRACT provisions of Arizona's air quality regulations. The modeling will be conducted based on the facility type, emission source(s), and potential emissions of HAPs obtained from the following sources:

- 2002 Toxic Release Inventory (TRI) for the State of Arizona
- 2002 Arizona HAP Emissions Inventory

- 2002 I-STEPS Emissions Database for the State of Arizona
- Data from previous air dispersion modeling provided by ADEQ
- Data provided by Maricopa, Pinal and Pima County Air Quality Departments (if available)
- Permit information

Facilities reporting at least 1 tpy of any single HAP, or at least 2.5 tpy of all HAPs combined, will be identified using the 2002 inventory supplied by ADEQ. These sources are potentially subject to HAPRACT.

The procedure outlined above will also be used to define the list of industries potentially subject to the HAPRACT rules. The general procedure will be as follows:

- Within each 4-digit SIC code, individual representative emission points will be chosen from the available emissions data sources, and paired with the total annual emissions from the HAP database for the facility where the emission point is located.
- Ambient air concentrations will then be modeled with a screening air dispersion model.
- If the concentrations predicted by the screening model for any HAP emitted by facilities within the SIC code are greater than 120 percent of the associated short-term (acute) or long-term (chronic) ambient air concentrations (AAC), then that 4-digit SIC code will be classified as potentially subject to HAPRACT.
- If the concentrations predicted by the screening model for all HAPs emitted by facilities within the SIC code are less than 80 percent of the associated short or long-term AAC, then that 4-digit SIC code will be not be classified as potentially subject to HAPRACT.
- If the concentrations predicted by the screening model for any HAP emitted by facilities within the SIC code are greater than 80 percent but less than 120 percent of the associated short or long-term AAC, then that 4-digit SIC code will be classified as potentially subject to HAPRACT and the AAC will be re-evaluated.

The following sections describe the specific approaches to be applied in each of the overall steps.

2.1 Emission Source Data

Emission source data (e.g., for stacks: height, inside diameter, exit velocity, exit temperature) will be required for the screening modeling. Each facility may have multiple stacks emitting multiple HAPs. If emission point data can be found for at least one facility within a 4-digit SIC code, then representative emission point(s) will be identified for each HAP using actual emission point characteristics. If no emission point data can be found, then a generic volume source will be used to represent the HAP emissions.

The following sources of information will be used to locate potential emission source data:

- 2002 I-STEPS database
- County agency databases (Maricopa, Pinal, and Pima Counties)
- ADEQ screening modeling files
- Permits

HAP emissions will be associated with emission points to the extent allowed by the available information. Only emission points identifiable as having one or more HAP compound emissions will be considered for modeling. For instance, a boiler stack found in the I-STEPS database is the only emission point found for a facility. If the facility emits styrene in excess of 1 tpy, but I-STEPS does not show styrene emitted by that boiler stack, then the boiler stack would not be considered for modeling the styrene emissions. In that case, the generic volume source approach would be used to model the facility.

2.2 Model Selection and Approach

The modeling procedures to be used to determine impacts of HAPs from the selected facilities will follow both EPA air quality modeling guidance (EPA, 1996) and ADEQ modeling guidance (ADEQ, 2004). The ADEQ modeling guidance recommends using EPA's SCREEN3 (EPA, 1995b) air dispersion model for initial screening evaluations of the HAPs concentrations as follows:

> "The current recommended model for screening sources in simple terrain is the most recent version of EPA's SCREEN3 model (or its successor). … SCREEN3 is a steady-state, single-source, Gaussian dispersion model developed to provide an easy-to-use method of obtaining pollutant concentration estimates. SCREEN3 is an EPA-approved screening model for estimating impacts at receptors located in simple terrain and complex terrain due to emissions from simple sources. The model is capable of calculating downwind ground-level concentrations due to point, area, and volume sources. In addition, SCREEN3 incorporates algorithms for the simulation of aerodynamic downwash induced by buildings. The model utilizes a range of worst-case meteorological data rather than using site-specific meteorological conditions." [ADEQ, 2004, pg. 8]

The latest version of the SCREEN3 model (dated 96043) will be used in the analysis. SCREEN3 will be run in flat-terrain mode, with rural dispersion, and the full array of meteorology to evaluate potential worst-case 1-hour impacts. The receptor array will begin at the nearest process area boundary from each source/stack and extend outward from the process area boundary to 10 kilometers. The nearest distance to each process area boundary from each facility and stack will be based on the actual configuration of each site. This information will be developed by ADEQ by locating facilities on topographical maps, aerial photographs, or other mapping resources. The process area is the area in which those processes that directly constitute emission generating activity at a facility are operated and contained. The process area is to include only the immediate vicinity of the currently utilized portions of the property (e.g., quarries, stockpiles, haul roads, work yards, and closely-related activity areas). Employee parking lots and offices are not considered part of the process area. Often times, the process area boundary is irregular in size and shape. In these cases, the closest boundary area to the stack will be selected as the beginning receptor distance. Natural topographic boundaries will be considered when determining the process area boundary. If a process area boundary cannot be determined from topographical survey maps, aerial photographs, or other mapping resources, the receptor grid will begin at 25 meters and extend to 10 kilometers. The automatic receptor generation option of SCREEN3 will be used to generate the receptor distances and determine the maximum impacts.

SCREEN3 will also be used to calculate concentrations in the cavity zone of buildings. If the cavity zone extends to distances that are beyond the process area boundary and they are higher than the simple terrain calculations, then these concentrations will be used for comparison to the hourly AACs. The cavity zone concentrations will not be used for comparison to the annual AACs. Calculated fumigation concentrations will not be considered.

The 1-hour average concentrations will be scaled to annual averages by using the ADEQ recommended scaling factors of 0.08. All sources will be evaluated at a unit emission rate of 1 gram per second (g/s). Ambient air impacts will be calculated by multiplying the SCREEN3 result by the actual source emission rate (also in g/s). Application of SCREEN3 in this manner is consistent with ADEQ's Modeling Guidelines.

2.3 Emission Sources

Emissions information will be obtained from ADEQ and local programs. For some facilities it will be easy to identify stack emissions. However, for other facilities a volume source approach may be more appropriate. This might include sources where the HAP emissions are emitted inside a building and then to the atmosphere through doors and windows or where there are multiple vents at various sizes and height throughout a building. For other sources such as landfills, an area source approach is more appropriate. The following sections describe the approaches for each type of emission source (point, volume, and area).

2.3.1 Point Sources

If multiple emission points are identified for a facility, each stack will be modeled separately, if possible and the maximum impacts from each stack will be summed for comparison to the AAC. If it cannot be determined which stack emits which pollutant, then a representative point will be selected using conservative objective criteria. If there are multiple stacks and/or fugitive (volume or area) sources emitting a HAP, then the maximum impacts from both the stacks and volume sources will be summed.

If multiple point sources are available and it cannot be determined which stacks emit which pollutants, then the point source with the minimum value of the quantity F_{stk} will be used. F_{stk} is calculated as follows:

$F_{stk} = h * V * T$, *where*
h = stack height (m)
V = stack volumetric flow (m^3/sec), and
T = stack exit temperature (K)

This factor is based on the parameter M used to select a representative stack for groups of collocated stacks found in EPA's *Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised* (EPA, 1992).

2.3.2 Volume Sources

For some facilities emissions will be modeled as volume sources as previously described. The volume source approach will also be used if specific emission point data cannot be identified from the ADEQ or local program databases for a facility. If multiple volume sources are to be modeled and it cannot be determined which volume sources emits which pollutant, then the volume source with the minimum value of the quantity of F_{vol} will be used. F_{vol} is calculated as follows:

$F_{vol} = h * \sigma_y * \sigma_z$, *where*
h = release height (m)
σ_y = initial horizontal dispersion (m)
σ_z = initial vertical dispersion (m)

This factor for volume sources is analogous to the factor for point sources. The initial volume source dimensions replace volumetric flow and temperature because they are the primary variables controlling volume source dispersion.

If emission point data for a facility cannot be identified from the ADEQ or local program databases, ADEQ will review topographical maps, aerial photographs, or other mapping resources to identify dimensions to use for modeling the source as a volume source. Guidance based on recommendations in the EPA ISC and Screen model user's guides

(EPA, 1995a and 1995b) will be followed for calculating σ_y and σ_z based on information obtained from the maps and aerial photography. If this information cannot be obtained or if the dimensions of σ_y and σ_z cannot be determined in this manner, then a generic volume source will be used as a surrogate representation. A volume source based on a 2-story (24-foot high, 100-foot long) building will be used and HAP emissions will be modeled from this source for the facility. For this surrogate source, the height will be set to 12 feet (3.66 m), σ_y will be set to 23.4 feet (100/4.3 or 7.1 m) and σ_z will be set to 11.2 feet (24/2.15 or 3.4 m). These height and initial volume source size values are based on recommendations in the EPA ISC and Screen model user's guides (EPA, 1995a and 1995b).

2.3.3 Area Sources

The area source option of SCREEN3 will be utilized for some sources. This would include sources such as landfills that do not have a gas collection system. Dimensions of the area sources will be determined by ADEQ by reviewing topographical maps, aerial photographs, and other mapping resources.

3.0 BACKGROUND

Background concentrations represent the contributions to outdoor air toxics concentrations resulting from natural sources, persistence in the environment of past years' emissions, and long-range transport from distant sources. Background concentrations could be levels of pollutants that would be found even if there had been no recent manmade emissions. To accurately estimate outdoor concentrations, it is necessary to account for background concentrations by adding them to the modeled concentrations (EPA, 2005).

Evaluation of background concentrations is pending the modeling results.

4.0 REFERENCES

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